

Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) EP 1 063 776 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
26.11.2003 Bulletin 2003/48

(51) Int. Cl. 7: H03M 13/29

(43) Date of publication A2:  
27.12.2000 Bulletin 2000/52

(21) Application number: 00110944.6

(22) Date of filing: 25.05.2000

(84) Designated Contracting States:  
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE  
Designated Extension States:  
AL LT LV MK RO SI

(72) Inventors:  
• Yano, Tetsuya, Fujitsu Limited  
Kawasaki-shi, Kanagawa 211-8588 (JP)  
• Obuchi, Kazuhisa, Fujitsu Limited  
Kawasaki-shi, Kanagawa 211-8588 (JP)  
• Kawabata, Kazuo, Fujitsu Limited  
Kawasaki-shi, Kanagawa 211-8588 (JP)

(30) Priority: 23.06.1999 JP 17661799

(71) Applicant: FUJITSU LIMITED  
Kawasaki-shi, Kanagawa 211-8588 (JP)

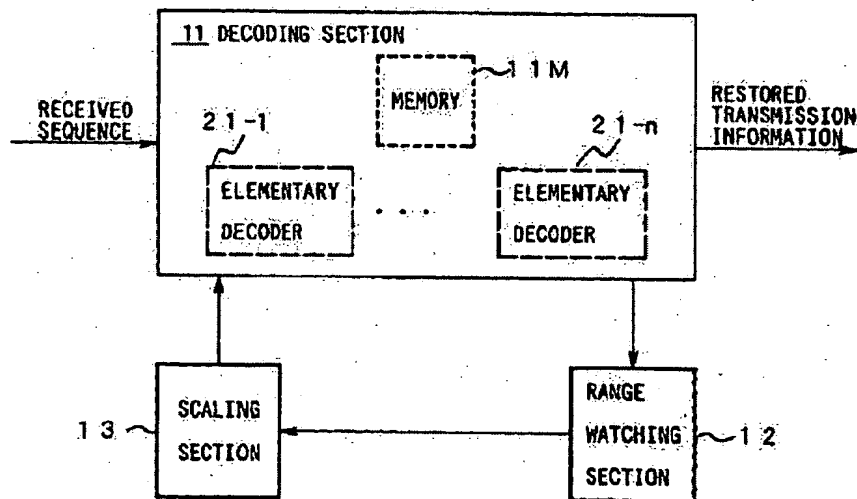
(74) Representative: HOFFMANN - EITLE  
Patent- und Rechtsanwälte  
Arabellastrasse 4  
81925 München (DE)

(54) Turbo decoder

(57) A turbo decoder is provided in which a distribution of likelihood values that are obtained during the course of turbo-decoding is watched and scaling of an operation object to be subjected to subsequent likelihood

hood computation of the turbo-decoding is performed in accordance with the distribution. This turbo decoder can reduce the cost, size, and power consumption of a transmission system and equipment, increase their reliability, and improve the transmission quality and performance.

FIG. 1





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 11 0944

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	BLAZEK Z ET AL: "A DSP-BASED IMPLEMENTATION OF A TURBO-DECODER" PROC. OF IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE (GLOBECOM), vol. 5, 1998, pages 2751-2755, XP000801545 Sydney, Australia ISBN: 0-7803-4985-7	1,7,19, 25,37,43	H03M13/29
Y	* page 2751, right-hand column - page 2752, left-hand column; figure 1 *	4,16,22, 28,34, 40,52	
A	* the whole document *		
X	PAPKE L ET AL: "IMPROVED DECODING WITH THE SOVA IN A PARALLEL CONCATENATED (TURBO-CODE) SCHEME" PROC. OF IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC), vol. 1, 23 June 1996 (1996-06-23), pages 102-106, XP000625650 Dallas, US ISBN: 0-7803-3251-2	1,10,37, 46	
Y	* page 103, left-hand column *	4,13,16, 28,34, 40,49,52	H03M
A	* page 104, right-hand column - page 105, left-hand column; figure 8 *		
	* the whole document *		
	---		
	-/--		
The present search report has been drawn up for all claims			
Place of search: <b>MUNICH</b>		Date of completion of the search: <b>21 August 2003</b>	Examiner: <b>Burkert, F</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons  a : member of the same patent family, corresponding document</p>			

EPO FORM 1523 (03-02) (P0401)



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 00 11 0944

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Incl. 7)
X,P	GIBONG JEONG ET AL: "Optimal quantization for soft-decision turbo decoder" PROC. OF VEHICULAR TECHNOLOGY CONFERENCE (VTC), 19 September 1999 (1999-09-19), pages 1620-1624, XP010353238 Amsterdam, Netherlands ISBN: 0-7803-5435-4	1	
X,P	* page 1623; figure 1 *	1	
A,P	* page 1622, left-hand column - page 1623, left-hand column; figure 1 *	2-54	
Y	D. DIVSALAR AND F. POLLARA: "Multiple Turbo Codes for Deep Space Communications" TDA PROGRESS REPORT, [Online] no. 42-121, 15 May 1995 (1995-05-15), pages 66-77, XP002251816 Retrieved from the Internet: <URL:http://tmo.jpl.nasa.gov/tmo/progress_report/42-121/121T.pdf> [retrieved on 2003-08-20]	4,13,22, 40,49	
A	* figure 4 *	5,6	TECHNICAL FIELDS SEARCHED (Incl. 7)
A	BERROU C ET AL: "Near Shannon limit error-correcting coding and decoding: Turbo-codes. 1" PROC. OF IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC), vol. 3, 23 May 1993 (1993-05-23), pages 1064-1070, XP010137024 Geneva, Switzerland ISBN: 0-7803-0950-2 * the whole document *	1-54	
-/-			
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 21 August 2003	Examiner Burkert, F
CATEGORY OF CITED DOCUMENTS:		T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date O: document cited in the application L: document cited for other reasons S: member of the same patent family, corresponding document	
X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document			

EPO FORM 1503 01/87 (P4/C01)



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 11 0944

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	RAMESH MAHENDRA PYNDIAH: "NEAR-OPTIMUM DECODING OF PRODUCT CODES: BLOCK TURBO CODES" IEEE TRANSACTIONS ON COMMUNICATIONS, IEEE INC. NEW YORK, US, vol. 46, no. 8, 1 August 1998 (1998-08-01), pages 1003-1010, XP000782280 ISSN: 0090-6778 * the whole document *	1-54	
A	LI J ET AL: "MULTI-DIMENSIONAL TURBO CODES: PERFORMANCE AND SIMPLIFIED DECODING STRUCTURE" IEEE TRANSACTIONS ON FUNDAMENTALS OF ELECTRONICS, COMMUNICATIONS AND COMPUTER SCIENCES, INSTITUTE OF ELECTRONICS INFORMATION AND COMM. ENG. TOKYO, JP, vol. E80-A, no. 11, 1 November 1997 (1997-11-01), pages 2089-2094, XP000768532 ISSN: 0916-8508 * page 2092 *	4-9	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	US 5 721 745 A (ANDERSON JOHN BAILEY ET AL) 24 February 1998 (1998-02-24) * figure 2 *	4-6	
A	HALTER S ET AL: "Reconfigurable signal processor for channel coding and decoding in low SNR wireless communications" PROC. OF IEEE WORKSHOP ON SIGNAL PROCESSING SYSTEMS (SIPS), 8 October 1998 (1998-10-08), pages 260-274, XP010303741 Cambridge, US ISBN: 0-7803-4997-0 * page 268 *	7-9	
The present search report has been drawn up for all claims			
Place of search <b>MUNICH</b>		Date of completion of the search <b>21 August 2003</b>	Examiner <b>Burkert, F</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document</p> <p>T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons S: member of the same patent family, corresponding document</p>			

EP 00 11 0944 (PCT/00/001)



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 00 11 0944

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DANESHGARAN F ET AL: "A novel constraint length 13 Viterbi decoder based on the iterative collapse algorithm" PROC. OF GLOBAL TELECOMMUNICATIONS CONFERENCE (GLOBECOM), vol. 1, 6 December 1992 (1992-12-06), pages 1255-1259, XP010062790 Orlando, US ISBN: 0-7803-0608-2 * page 1258 *	10-18	
A	LANG LIN ET AL: "Improvements in SOVA-based decoding for turbo codes" PROC. OF IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS, 8 June 1997 (1997-06-08), pages 1473-1478, XP010226998 Montreal, Canada ISBN: 0-7803-3925-8 * page 1473 - page 1476 *	19-36	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
The present search report has been drawn up for all claims.			
Place of search <b>MUNICH</b>		Date of completion of the search <b>21 August 2003</b>	Examiner <b>Burkert, F</b>
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : member of the same patent family, corresponding document</p>			

EPO FORM 1533 (03.02.2001)



European Patent  
Office

Application Number

EP 00 11 0944

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

**LACK OF UNITY OF INVENTION**

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:



European Patent  
Office

LACK OF UNITY OF INVENTION  
SHEET B

Application Number  
EP 00 11 0944

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions; namely:

1. Claims: 1,2,3,5,6,8,9,11,12,14,15,17,18,20,21,23,24,26,27,  
29,30,32,33,35,36,38,39,41,42,44,45,47,48,50,51,53,  
54

A turbo decoder with scaling of the extrinsic information, in which the soft channel values (LLRs) representing the systematic bit ("non-coded word") are scaled by a scaling factor, which is determined by a scaling means in dependence on a distribution of likelihood values obtained during the course of turbo decoding.

2. Claims: 4,13,22,31,40,49

A turbo decoder with scaling of the extrinsic information, which comprises  $n$  elementary decoders with  $n$  being smaller than the dimension of the parallel concatenated turbo code (where the dimension denotes the number of component codes).

3. Claims: 10,28,46

A turbo decoder with scaling of the extrinsic information, which comprises memory to be used for interleaving and deinterleaving, where the scaling of the extrinsic information is performed while reading from said memory.

4. Claim : 19

A turbo decoder with scaling of the extrinsic information, in which the scaling factor reduces the width of the range of likelihood values below a prescribed threshold, if the width of the range has exceeded this threshold.

5. Claim : 37

A turbo decoder with scaling of the extrinsic information, in which a range watching means obtains a distribution of likelihood values as a maximum value or as an average of likelihood values obtained in previous steps.

6. Claims: 7,16,25,34,43,52

A turbo decoder with scaling of the extrinsic information, which comprises a single elementary decoder that decodes all component codes of the turbo code in series, where the component codes may be different

# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 00 11 0944

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-08-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5721745 A	24-02-1998	AU 716645 B2	02-03-2000
		AU 2459197 A	12-11-1997
		BR 9702156 A	20-07-1999
		CA 2221295 A1	30-10-1997
		CN 1189935 A B	05-08-1998
		CZ 9704073 A3	17-06-1998
		EP 0834222 A1	08-04-1998
		HU 9901440 A2	30-08-1999
		JP 11508439 T	21-07-1999
		NO 975966 A	18-12-1997
		PL 323524 A1	30-03-1998
		PL 183537 B1	28-06-2002
		PL 184230 B1	30-09-2002
		RU 2187196 C2	10-08-2002
		WO 9740582 A1	30-10-1997
		ZA 9703217 A	18-12-1997

EPO FORM P4552

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82



**This Page is Inserted by IFW Indexing and Scanning  
Operations and is not part of the Official Record**

**BEST AVAILABLE IMAGES**

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☒ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: \_\_\_\_\_

**IMAGES ARE BEST AVAILABLE COPY.**

**As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.**